OCCASIONAL PAPER 115 NOVEMBER 1950

AMOUNT OF CHIPPABLE WASTE

AT SOUTHERN PINE SAWMILLS

By
Roswell D. Carpenter

SOUTHERN FOREST EXPERIMENT STATION
Chas. A. Connaughton, Director
New Orleans, La.
FOREST SERVICE, U.S. DEPT. OF AGRICULTURE

AMOUNT OF CHIPPABLE WASTE AT SOUTHERN PINE SAWMILLS

By
Roswell D. Carpenter
Southern Forest Experiment Station

This paper summarizes the results of a study of the amount of wood waste, suitable for pulp chips, produced at four different classes of southern pine sawmills. The study, carried out between October 1948 and February 1950, was made cooperatively by the Southern Kraft Division of the International Paper Company and the Southern Forest Experiment Station.

Study Methods

Results were obtained at 16 sawmills in northern Louisiana and in southern and central Arkansas. On the basis of their sawing equipment, the mills were divided into four classes:

Class 1	Band headsaw with resaw
Class 2	Solid-tooth circular headsaw with resaw and shotgun carriage feed
Class 3	Solid-tooth circular headsaw with steam feed (small gun); no resaw
Class 4	Portable mill with circular headsaw using inserted bits; no resaw

Two mills of each class were in Arkansas and two in Louisiana.

Most of the study logs were loblolly and shortleaf pine. At some of the mills, a few longleaf logs were included. All logs were peeled before sawing. Practically all of the logs came from second-growth timber, and the volume of heartwood was so small that it was included with the sapwood in computing the waste.

At each of the mills, an attempt was made to secure data on waste from the number of logs indicated in the tabulation at the right. Only one log was obtained in the two largest diameter groups. In the other diameter groups, it was not possible to get the desired number of logs at every mill, but enough were studied to assure statistically reliable results and to give a sound basis for comparisons between classes of mills.1/

Diameter group (inches)	Scaling diameters included	Logs desired
	Inches	Number
6	4.51 to 6.50	20
8	6.51 to 9.50	50
11	9.51 to 12.50	50
14	12.51 to 15.50	50
17	15.51 to 18.50	20
20	18.51 to 21.50	20
23	21.51 to 24.50	5
26	24.51 to 27.50	5
29	27.51 to 30.50	5

The procedure for determining the amount of waste was the same at each mill. Logs were peeled by hand and then segregated by diameter groups. For each log the average diameter was taken to the nearest 1/10 inch at the small end, middle, and large end. All diameter measurements were taken inside bark with calipers. Length was measured to the nearest 1/10 foot with a steel tape. Net Doyle scale, inside bark, was recorded. Logs were reduced in volume for sweep in excess of 2 inches and for rot, fire scars, and other deductible defect; and those under 8.5 inches in diameter were given a scale equal to their length. The volume in cords of waste per thousand board feet has not been adjusted to a base of 16-foot log length because the average log length of both the study logs and those found in a subsequent analysis of the annual log intake closely approached this figure.

The peeled logs in each diameter group were weighed to the nearest 5 pounds.

The logs were put through the sawmill by diameter groups and data were recorded separately for each group. A piece tally of the lumber by length, width, and thickness was made by the sawmill's lumber grader. Six samples of the green wood were taken at random from the sapwood portion of the lumber in each diameter group, and the moisture content was determined by the oven-dry method.

1/ Tables of the standard error and standard error in percent of the mean of the waste in cords by mill classes for Arkansas and Louisiana show fairly consistent results. For all mill classes, the greatest error is in the 8- and 11-inch diameter groups.

All slabs, edging strips, and end trim from each group were collected and weighed immediately after sawing. For at least two mills in each class, the waste was then sorted into chippable and non-chippable material. For the purposes of the cooperators, non-chippable material consisted of thin, ribbon-like pieces of edging strips and all heavier material less than one foot long. The amount of such material varied by diameter classes (see footnote to table 4, page 7) but averaged only 6 percent of the total heavy waste. Weight or volume of sawdust was not determined. The data on heavy waste were computed in terms of weight and then converted, taking 2,500 pounds of oven-dry wood as the equivalent of one cord.

This phase of the study gave the volume of waste for the study logs only. In order to determine the total volume of waste produced by the different study mills, it was necessary to determine the log intake pattern (by diameter and length) for the individual mills. This information was obtained from a study of each mill's log scale sheets for each tenth sawing day throughout the first half of 1948.

Amount of Waste

The amount of chippable waste produced per thousand board feet, green lumber tally, was 0.43 cord for class 1 mills, 0.46 cord for class 2 mills, and 0.61 cord for mills in classes 3 and 4. In 1948, the average study mill in class 1 or 2 cut about 8,000 M board feet of pine lumber, and thus produced about 3,500 cords of chippable waste. Class 3 study mills, with an average annual cut of 4,800 M board feet of pine, had 2,900 cords of heavy waste; and class 4 mills, with only half the lumber output of the class 1 mills, still produced over two-thirds as much waste. The volume of chippable waste for the study mills, as calculated from the 1948 log intake records, is shown in table 1.

Table 1.--Waste production at 16 study mills, 1948

Mill class	Lumber production	Chippable waste	Chippable waste per M b.f.
	M b.f. green lumber tally	Cords	Cords
1	32,465	13,992	0.43
2	31,949	14,601	.46
3	19,218	11,742	.61
4	15,836	9,676	.61

The main factor governing the amount of waste produced proved to be the diameter of the logs being sawed. Mill class was a secondary influence. The production of waste by log diameter and mill class is shown in table 2.

Table 2.--Chippable waste per M board feet, green lumber tally, from study logs

Diameter group (inches)	Mill class			
	1	2	3	4
	Cords			
6	0.76	0.81	0.90	0.69
8	.62	.54	.77	.82
11	.47	.43	.46	.57
14	.36	.35	.33	.40
17	.31	.28	.29	.24
20	.33	.24	.27	.27
23	.34	.19	.26	.25
26	...	.14	...	...

In mills of all classes, small logs produced the most waste and large logs the least. With a few minor exceptions, the proportion of waste for all mill classes decreased regularly as log diameter increased. Thus, in the log diameter groups between 6 and 23 inches, the waste factors in cords per thousand board feet, green lumber tally, declined from 0.76 to 0.34 cord for class 1 mills; from 0.81 to 0.19 cord for class 2 mills; and from 0.90 to 0.26 cord for class 3 mills. In class 4 mills, the waste factor rose from 0.69 cord in 6-inch logs to 0.82 cord for 8-inch material, but then declined to 0.25 cord at 23 inches.

For most diameter groups, class 2 mills produced less waste than mills of other classes. Class 4 mills produced somewhat more waste than other mills in logs from the 8-, 11-, and 14-inch diameter groups. These groups are the ones from which all classes of study mills drew the greatest volume of wood. The log intake patterns (the percentages of green lumber tally produced from logs of specified diameter groups) for the mills of various classes are shown in table 3. The table shows that mills in classes 2, 3, and 4 get about 95 percent of their cut from logs less than 15.5 inches in diameter. Mills in class 1 get only 82 percent of their cut from logs of these sizes.

Table 3.--Percent of 1948 green lumber tally produced from logs of specified diameter groups, by mill class

Diameter group (inches)	Mill class			
	1	2	3	4
	Percent			
6	1.2	2.7	8.1	2.9
8	13.8	33.9	43.7	32.6
11	35.1	41.5	33.6	42.3
14	32.1	17.0	11.0	16.0
17	13.2	4.0	2.5	5.3
20	4.2	.6	1.0	.8
23	.4	.3	.1	.1
	100.0	100.0	100.0	100.0

As is evident from the overrun figures in table 4 (column 6), mills in classes 1 and 2 usually get more lumber from a log of given diameter than do the mills in classes 3 and 4. This extra output stems from the fact that class 1 and 2 mills have thinner headsaws as well as resaws, and therefore cut less kerf than mills in the other classes. In evaluating the performance of the class 1 mills, it should also be remembered that they cut more 1-inch boards and less 2-inch dimension lumber than class 3 and 4 mills.

Figure 1 charts the performance of the various mill classes on logs of different diameter groups. Table 4 gives factors for total waste and other information on the study logs.

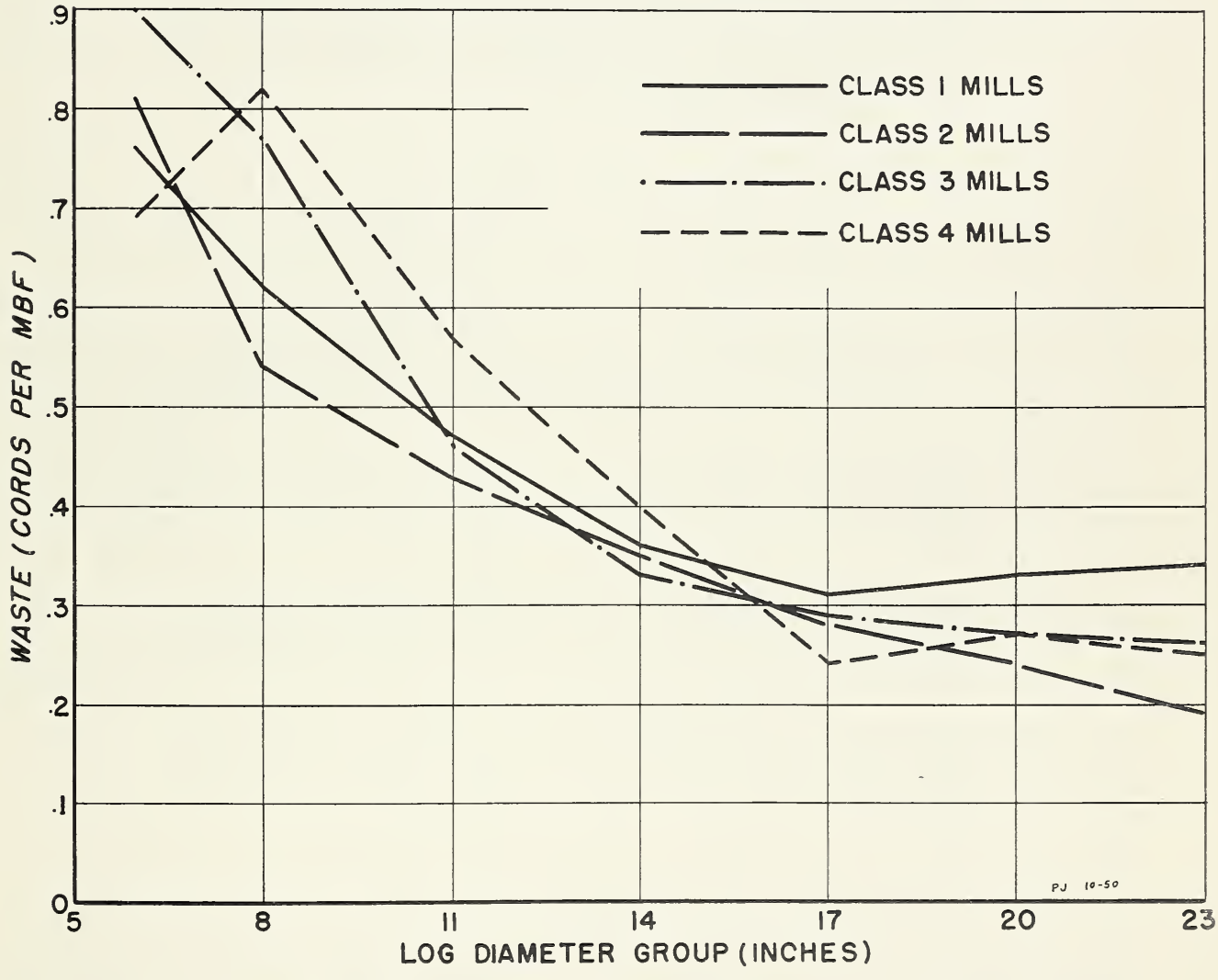

Figure 1.--Average amounts of chippable waste (in cords of waste per M board feet, green lumber tally) produced by study mills.

Application of Results

The waste factors developed in this study may be used to predict, with reasonable accuracy, the production of total heavy wood waste at most mills cutting southern pine timber. The steps in calculating wood waste are:

1. Place mill in its appropriate class.

2. Determine the percentage of annual log intake that comes from each of the diameter groups used in the present study. The records for every tenth sawing day for 6 months, or for every twentieth sawing day for a year, should be adequate for this purpose. The proportions of log intake should be expressed in percentage of green lumber tally from logs of the different diameters.

   Suggested steps in doing this are:

   a. Determine for the above period the log scale for logs of the various diameter groups.

   b. Use the average overrun percentage figures (based on green chain lumber tally) per diameter group as shown in table 4 (column 6).

3. Multiply the percent of the lumber tally in each diameter group by the factor for total waste for that group as given in table 4 (column 9).

4. The sum of these figures is the weighted amount of waste per thousand board feet of lumber produced during the sample period.

5. Multiply the weighted average amount of waste per thousand board feet by the total annual output of the mill.

Table 4.--Total and chippable pine waste from study logs

Diameter class (inches)	Mills	Logs	Net scale, Doyle	Green lumber tally	Overrun, based on green chain lumber tally	Total waste 1/,2/	Total waste per M b.f. 2/		Chippable 2/,3/		
										Waste per M b.f.	
							Doyle scale	Green lumber tally	Total chippable	Doyle scale	Green lumber tally
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	-- Number --		-- Bd. ft. --		Percent	---------- Cords ----------					
					Class 1 Mills						
6	2	53	782	763	-2	0.60	0.76	0.78	0.58	0.74	0.76
8	4	197	3,713	6,943	87	4.45	1.20	.64	4.27	1.15	.62
11	4	205	9,288	14,611	57	7.29	.78	.50	6.93	.75	.47
14	4	201	18,125	24,596	36	9.41	.52	.38	8.75	.48	.36
17	4	93	14,212	16,669	17	5.73	.40	.34	5.22	.37	.31
20	4	41	9,211	10,142	10	3.68	.40	.36	3.35	.36	.33
23	2	7	2,187	2,179	0	.82	.38	.38	.75	.34	.34
Total or average	...	797	57,518	75,903	32	31.98	.56	.42	29.84	.52	.39
					Class 2 Mills						
6	3	48	678	755	11	.63	.93	.84	.61	.90	.81
8	4	251	4,652	9,297	100	5.27	1.13	.57	5.06	1.09	.54
11	4	226	9,725	14,919	53	6.70	.69	.45	6.36	.65	.43
14	4	167	14,796	18,312	24	6.94	.47	.38	6.45	.44	.35
17	3	35	4,896	5,664	16	1.72	.35	.30	1.56	.32	.28
20	2	19	3,812	3,862	1	1.00	.26	.26	.91	.24	.24
23	2	4	1,147	1,147	0	.24	.21	.21	.22	.19	.19
26	1	1	331	301	-9	.04	.14	.15	.04	.12	.14
Total or average	...	751	40,037	54,257	36	22.53	.56	.42	21.21	.53	.39
					Class 3 Mills						
6	4	76	1,159	1,480	28	1.37	1.18	.92	1.32	1.14	.90
8	4	287	5,195	8,957	72	7.21	1.39	.80	6.92	1.33	.77
11	4	230	9,686	13,520	40	6.52	.67	.48	6.19	.64	.46
14	4	156	13,667	16,079	18	5.66	.41	.35	5.27	.38	.33
17	4	62	9,056	9,701	7	3.09	.34	.32	2.81	.31	.29
20	3	47	10,006	10,156	1	3.04	.30	.30	2.77	.28	.27
23	2	5	1,498	1,370	-9	.40	.26	.29	.36	.24	.26
Total or average	...	863	50,267	61,263	22	27.28	.54	.44	25.64	.51	.42
					Class 4 Mills						
6	2	37	510	693	36	.49	.96	.70	.48	.94	.69
8	4	252	4,361	7,750	78	6.64	1.52	.86	6.39	1.46	.82
11	4	212	8,849	12,620	43	7.60	.86	.60	7.23	.82	.57
14	3	105	8,574	10,542	23	4.56	.53	.43	4.24	.50	.40
17	3	23	3,113	3,497	12	.94	.30	.27	.86	.28	.24
20	2	22	4,122	3,977	-4	1.16	.28	.29	1.06	.26	.27
23	1	6	1,542	1,354	-12	.37	.24	.27	.34	.22	.25
Total or average	...	657	31,071	40,433	30	21.76	.70	.54	20.59	.66	.51

1/ Moisture content of all material in this study was 50.51 percent of green weight and varied between extremes of from 34.73 to 61.34 percent. Calculated by the lumberman's method, the moisture content of all material was 102.05 and varied between extremes of 53.20 and 158.66.

2/ Minor discrepancies between means and totals are due to the fact that sufficient significant digits are not carried in the means.

3/ The proportion of total waste that was chippable was 97 percent for 6-inch logs, 96 percent for 8-inch logs, 95 percent for 11-inch logs, 93 percent for 14-inch logs, and 91 percent for 17+-inch logs. For all study logs combined, the proportion was 94 percent.